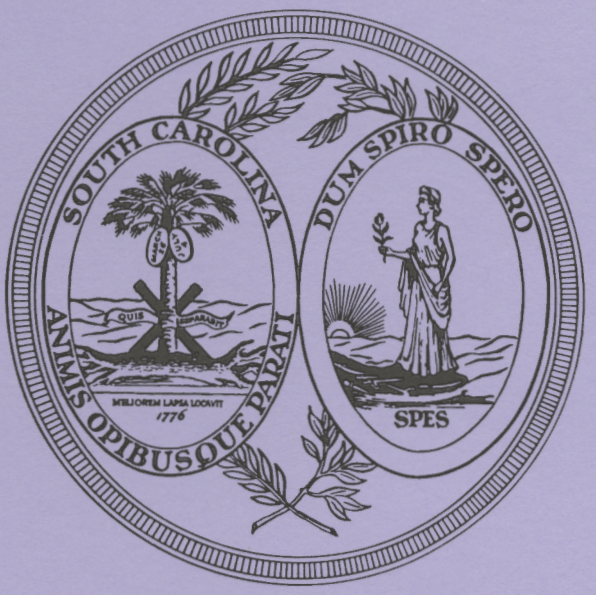
SOUTH CAROLINA
SEA GRANT CONSORTIUM



ANNUAL REPORT
1991-1992

Printed Under The Direction Of The
State Budget And Control Board

S.C. SEA GRANT CONSORTIUM

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Working together to sustain our coastal resources through research, education and extension programs.

October 15, 1992

The Honorable Carroll A. Campbell, Jr., Governor
The Honorable Members of the South Carolina General Assembly

Your Excellency, Ladies and Gentlemen:

On behalf of the South Carolina Sea Grant Consortium and its Board of Directors, it is my pleasure to present to you the annual report of the S.C. Sea Grant Consortium for fiscal year 1991-1992, our twelfth year of operation.

We appreciate your continued assistance and cooperation, and look forward to working with you during the next year.

Please do not hesitate to call on us if we can be of service.

Respectfully submitted,

THE S.C. SEA GRANT CONSORTIUM BOARD OF DIRECTORS

Dr. James B. Edwards
Chairman

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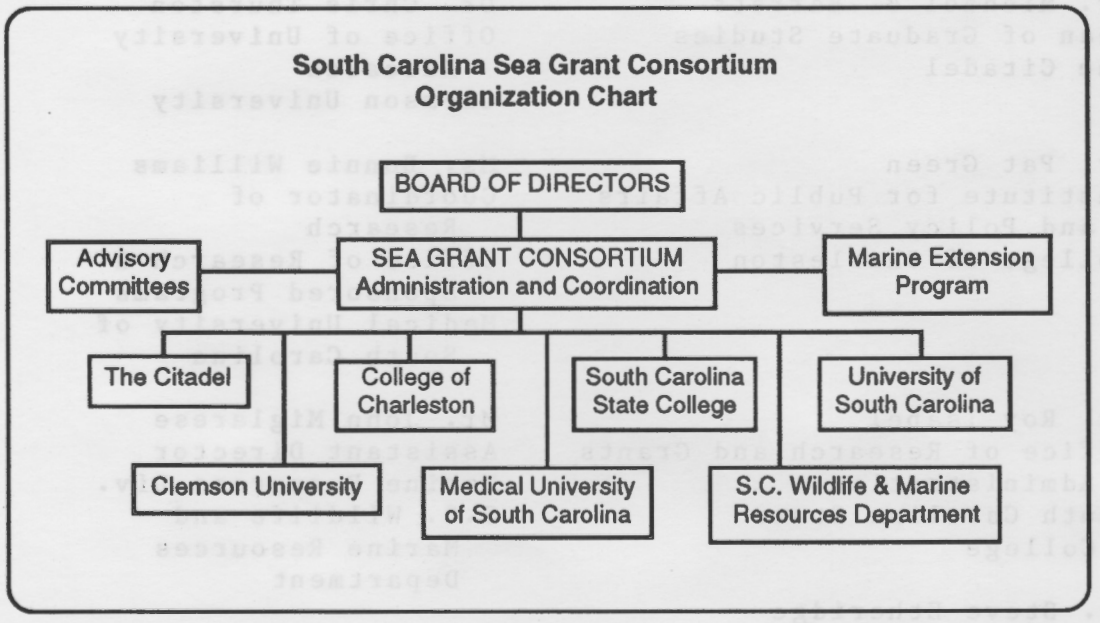


THE SOUTH CAROLINA SEA GRANT CONSORTIUM

Created by South Carolina Act No. 643 in 1978 (amended May 6, 1987, R106, H2331), the principal purpose of the South Carolina Sea Grant Consortium is to provide a mechanism for the development and management of the Sea Grant Program for the state of South Carolina and adjacent regions that share a common environment and resource heritage. The Consortium serves to support, improve and share research, education, training, and extension programs in fields related to ocean and coastal resources. The Consortium further encourages and follows a regional approach to solving problems or meeting needs relating to ocean and coastal resources in cooperation with appropriate institutions, programs, and persons in the region.

Charter Members

The membership of the Consortium consists of the College of Charleston, Clemson University, the Medical University of South Carolina, South Carolina State College, S.C. Wildlife and Marine Resources Department, The Citadel and the University of South Carolina. These members are designated as charter members.

The terms of the membership are perpetual, and a majority of the charter members may vote the admission of a new member into the Consortium.

Board of Directors

The Board of Directors for the Consortium is comprised of the chief executive officer of each of the participating educational institutions and state agencies or his designee.

Executive Director

The Board has the express power to employ the Consortium Director, who has the following powers and duties:

1. directs supervision over all Consortium proposals;
2. prepares Consortium proposals to be submitted to interested agencies;
3. prepares an annual summary of all submitted proposals;
4. negotiates funding levels for proposals submitted by member institutions;
5. provides an accounting to the board of the director's development funds;
6. requests and receives funds from local, state,

federal, and private sources for use by the director, Consortium, individual member institutions, or other persons;

7. gathers, maintains, and makes available to interested persons natural resource information from state and federal agencies, higher education institutions, and any other appropriate entity;
8. designates the location of the consortium office, subject to the approval of the board;
9. exercises all incidental powers necessary to carry out the provisions of this chapter.

Advisory Committee

The Sea Grant Director is to be assisted by an advisory committee which consists of seven members who serve for four-year terms. These seven people, representing private coastal and marine users, are to be appointed to assist the Director with the identification of statewide and regional constituent needs. To date, the advisory committee has yet to be selected and convened.

In addition, six program area advisory groups, consisting of two research professionals, two private sector representatives, and one public offical, assist in the identification of research projects and their incorporation into a cohesive program area package.

OVERVIEW

The South Carolina Sea Grant Consortium is a unique partnership of universities, colleges and one state agency working to promote and implement research, education and extension programs in the sphere of marine and coastal resources. The Consortium accomplishes these concurrent tasks by drawing on the diverse and extensive talents and expertise available at its seven constituent institutions:

* The Citadel
* Clemson University
* College of Charleston
* Medical University of South Carolina
* South Carolina State College
* South Carolina Wildlife & Marine Resources Department
* University of South Carolina

The Consortium is charged with bringing together and coordinating the diverse and extensive talents and expertise of its constituent institutions to assist the state in resolving coastal and marine issues. Three

distinct advantages are realized by this "partnership" mechanism:

* Duplication, often a problem in scientific research, is avoided by encouraging cooperation among the different institutions and among different disciplines within the institutions.

* The promotion of manpower sharing results in greater productivity and lower costs.

* The ability to put together teams of faculty and staff from the various member institutions to help solve problems of concern to the state maximizes the effectiveness of existing personnel at the lowest possible cost. Because of this, the South Carolina Sea Grant Consortium office can operate efficiently with a very small staff.

As an independent state agency, the Consortium has expanded its efforts in marine research programs, educational activities, and technical and extension services: it serves as a "broker" between its member institutions and those individuals, industries, and agencies that can benefit from the results of such a range of programs. The emphasis is placed on applied research based upon the needs identified by potential users; the information gained from Consortium activities is then transferred to those users. In other words, the Consortium acts as an information synthesis and dissemination clearinghouse.

The Consortium is responsible for the administration and management of the Sea Grant Program for the state of South Carolina. The National Sea Grant College Program, signed into law in 1966, awards competitive grants to some 31 coastal and Great Lakes states for the express purpose of accelerating the national development of marine resources, including their conservation, proper management, and economic utilization. It is through research, education and extension work that the objectives of the National Sea Grant College Program are implemented and realized.

The Consortium derives its major funding from several sources -- the state of South Carolina, the National Sea Grant College Program and other federal and private funding sources. Through an annual appropriation from the State, the Consortium receives funding to support the staff, program overhead, and the program development fund. The National Sea Grant College Program Office provides funding primarily for full-scale research, education, and extension service projects. This commitment by both the state and the

federal government in supporting the Sea Grant Consortium is representative of the cooperative nature of the Consortium as it addresses coastal and marine resource issues.

The Consortium is guided in its policy decisions at the state level by its Board of Directors. The Board, which consists of the chief executive officer of each of the Consortium's member institutions, meets regularly to review the Consortium's program and to propose new directions for broadening the scope of its activities.

To facilitate administrative interaction between the Consortium and the faculty and staff of its member institutions, each institution has designated a liaison within its Sponsored Research or Financial Office. These liaisons provide a direct link between investigators and Consortium staff on matters dealing with the proposal process, processing of grants and awards, and oversight of ongoing projects and programs.

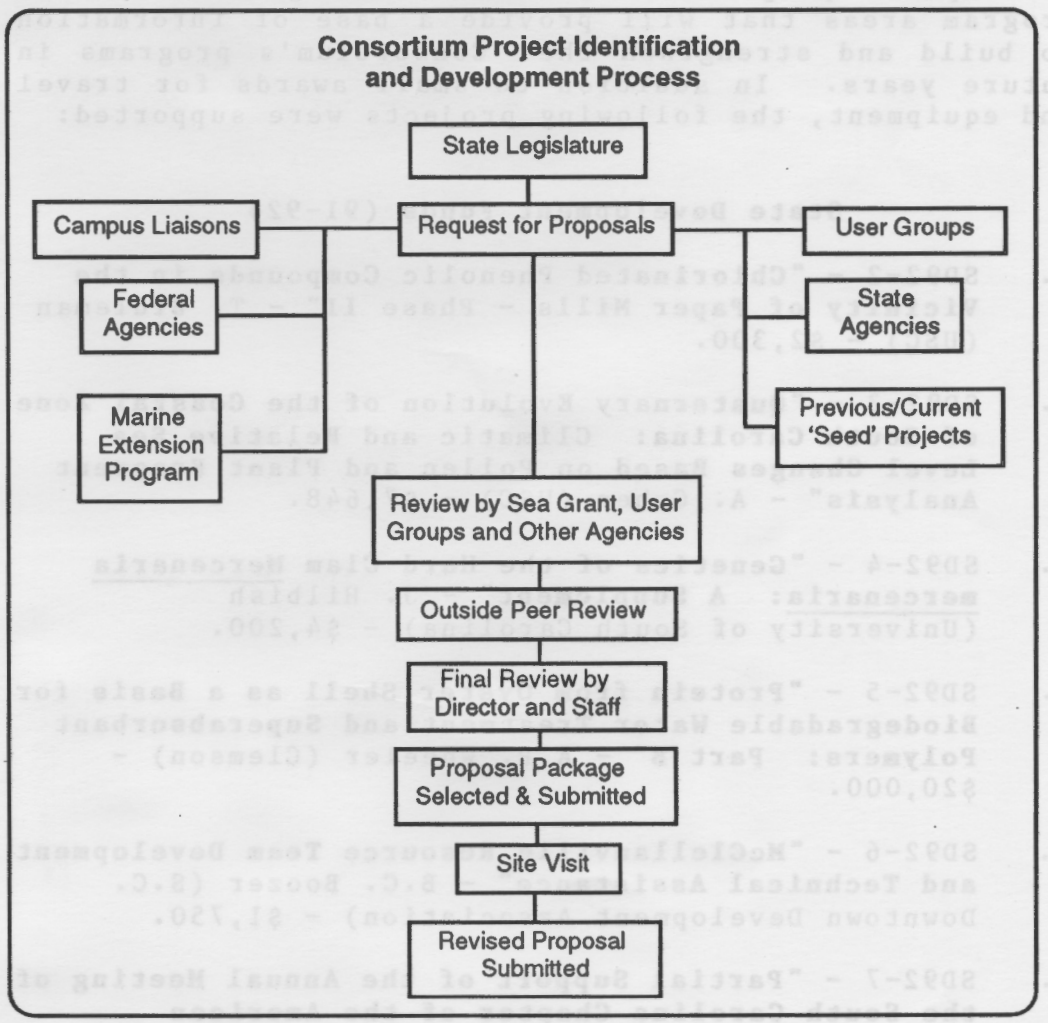
Actual research, education, and extension work on Consortium projects is, of course, carried out by the faculty and staff at the institutions. Their expertise and talent are strengths of the South Carolina Sea Grant Consortium; enabling it to meet the challenge of developing and managing coastal resources in an efficient and comprehensive fashion. Both faculty and staff approach this challenge from the variety of perspectives inherent in their multi-disciplinary fields.

In addition to providing professional expertise in many marine and coastal disciplines, member institutions are able to provide a wide range of facilities for use by Consortium project investigators. These investigators have access to more than 30 research laboratories, including those of the South Carolina Wildlife and Marine Resources Department at Fort Johnson and the James M. Waddell, Jr. Mariculture Research and Development Center in Victoria Bluff, and a large biomedical research facility of the Medical University of South Carolina. Six research vessels are available for field studies. Clemson University possesses the best agricultural engineering facilities for technological development and refinement in the state. Further, among the several field laboratories found throughout South Carolina, the University of South Carolina's 5000 square foot Belle W. Baruch Laboratory in Georgetown County provides a staff of twelve research associates and technicians with a fully equipped facility, including living quarters, and a large conference center.

PROGRAM DEVELOPMENT

General

The South Carolina Sea Grant Consortium has instituted a structured mechanism for its program identification and development process. Program areas are identified by the Consortium staff and program area advisors in consultation with state and federal natural resource agencies, private industry, and Marine Extension Program personnel. The project identification and development process outlined in the chart below is used in the development of the biennial proposal to the National Sea Grant College Program and, generally, for proposals to other funding sources.



For fiscal years 1990-92, the Consortium received some 25 initial proposals in response to its biennial call for proposals. Review of these proposals by qualified professionals from academia, government, and industry throughout the United States via written evaluations and on-site meetings was followed by submission of invited, fully-developed proposals. Fourteen of these proposals were included in the Consortium's FY90-92 biennial proposal package to the National Sea Grant College Program Office for final review and consideration; six proposals were subsequently funded. These are summarized in the next section.

In addition to federal Sea Grant project support, the Consortium Director is provided federal and state program development funds to allow for program flexibility and prompt response to high priority needs, to encourage innovative ideas and approaches, and to provide special support as needs arise. A number of development projects were funded during FY1991-92 in program areas that will provide a base of information to build and strengthen the Consortium's programs in future years. In addition to small awards for travel and equipment, the following projects were supported:

State Development Funds (91-92)

A. SD92-2 - **"Chlorinated Phenolic Compounds in the Vicinity of Paper Mills - Phase II"** - T. Bidleman (USC) - $2,300.

B. SD92-3 - **"Quaternary Evolution of the Coastal Zone of South Carolina: Climatic and Relative Sea Level Changes Based on Pollen and Plant Fragment Analysis"** - A. Cohen (USC) - $7,648.

C. SD92-4 - **"Genetics of the Hard Clam Mercenaria mercenaria: A Supplement"** - J. Hilbish (University of South Carolina) - $4,200.

D. SD92-5 - **"Protein from Oyster Shell as a Basis for Biodegradable Water Treatment and Superabsorbant Polymers: Part B"** - A.P. Wheeler (Clemson) - $20,000.

E. SD92-6 - **"McClellanville Resource Team Development and Technical Assistance"** - B.C. Boozer (S.C. Downtown Development Association) - $1,750.

F. SD92-7 - **"Partial Support of the Annual Meeting of the South Carolina Chapter of the American Planning Association"** - J.S. Dykes (Charleston County Planning Department) - $300.

G. SD92-8 - **"Sweetgrass Newsletter Project"** - D.P. DeNatale and M. Middleton (University of South Carolina) - $ 3,484.

H. SD92-9 - **"Support for the 1992 S.C. Fisheries Workers Association Meeting"** - J. Whetstone (S.C. Marine Extension Program) - $300.

Sea Grant Development Funds (FY91-92)

A. P/M-2A - **"Protein from Oyster Shell as a Basis for Biodegradable Water Treatment and Superabsorbant Polymers: Part B"** - A.P. Wheeeler (Clemson) - $20,000.

B. P/M-2B - **"Support for a Conference on Introductions and Transfers of Marine Species"** - M.R. DeVoe (SCSGC) - $2,500.

C. P/M-2C - **"Quaternary Evolution of the Coastal Zone of South Carolina: Climatic and Relative Sea Level Changes Based on Pollen and Plant Fragment Analysis"** - A. Cohen (USC) - $7,442.

D. P/M-2D - **"Support of the Sea Grant Best Student Paper Awards at the 1992 Inter-American Crustacean Society Meeting"** - E. Wenner (SCWMRD) - $1,250.

E. P/M-2E - **"Mechanisms of Transport of Larval Fishes and Decapod Crustaceans Through Estuarine Inlets"** - E. Wenner and C. Barans (MRRI-SCWMRD) - $7,500.

F. P/M-2G - **"Travel Support for NOAA Ship FERREL"** - T. Tisue (Clemson) - $5,000.

G. P/M-2H - **"Mechanisms of Transport of Larval Fishes and Decapod Crustaceans Through Estuarine Inlets"** - J. Blanton and P. Verity (Skidaway Institute of Oceanography) - $7,500.

H. P/M-2I - **"Development of Broodstock and Intensive Production Techniques for Hybrid Striped Bass Aquaculture"** - T.I.J. Smith (MRRI-SCWMRD) - $15,000.

I. P/M-2J - **"Techniques for Modeling Flow Across a Vegetated Salt Marsh"** - B. Kjerfve (USC) - $3,000.

J. P/M-2K - **"Coping with Listeria in the 90s - A Workshop"** - W. Rickards (Virginia Sea Grant College Program) - $500.

K. P/M-2L - **"Enrichment Program for the 1992 for the Lowcountry Science Fair"** - W. Kubinec (College of Charleston) - $1,500.

L. P/M-2M - **"Speaker Support for the First International Workshop on the Culture of Bivalve Mollusks"** - J.J. Manzi (Atlantic LittleNeck ClamFarms) - $2,000.

M. P/M-2N - **"Travel Support for NOAA Ship FERREL"** - T. Tisue (Clemson) - $2,200.

N. P/M-2O - **"Support for the Eighth International Meiofauna Conference"** - C. D'Elia (University of Maryland Sea Grant) - $500.

SEA GRANT PROGRAM DESCRIPTION AND REVIEW

The South Carolina Sea Grant Consortium manages and administers the Sea Grant College Program for the State. As its primary responsibility, the Consortium develops a program that focuses on institutional research, marine education, and marine extension services. Since 1980, the Consortium has administered over $12 million in federal and state-appropriated funds for over 290 research, education and extension service projects. For the 1991-92 fiscal year, projects were funded at a combined federal-state level of over $1.1 million. More important, however, are the major economic effects accrued to the state, the region, and, in many cases, the nation from these investments.

Institutional Research

Marine and coastal research programs undertaken by Sea Grant Consortium investigators are categorized into five program areas:

* Living Marine Resources
* Marine Environmental Research
* Coastal Resources Development and Management
* Bioengineering and Marine Technology
* Coastal Processes

During its first five years as a fully operational, independent state agency, the South Carolina Sea Grant Consortium gave preliminary consideration to a wide range of marine related projects. Beginning in FY1985-86, the Consortium's Program Proposal reflected a change in direction and a shift from broad, short-term projects to focused, long-term program areas. This transition implied a commitment to addressing major

needs and concerns of coastal and marine users and managers through objective-oriented, integrated efforts.

This section provides the reader with a brief overview of the six fully developed proposals selected, grouped into the five program areas.

Living Marine Resources

The coast of South Carolina includes over 504,000 acres of wetlands and miles of tidal rivers and creeks, which are home to a number of important commercial and recreational species of finfish and shellfish. In addition to providing natural habitat for these important resources, South Carolina coastal waters include many areas in which a variety of species can be raised in aquaculture operations. In both instances, consideration must be given to maintaining high quality habitats, ensuring access to these areas and balancing the needs of fishermen, aquaculturists and other resource users.

The South Carolina Sea Grant Consortium has organized its aquaculture and fisheries research programs under the Living Marine Resources program area in recognition of these mutual needs.

Aquaculture

The development of aquaculture has evolved slowly in the United States as compared to other countries of the world, where aquaculture plays a significant role in their economies. With growing U.S. consumer desire for seafood exceeding domestic supply, the concept of aquaculture has been gaining national attention. This is true for South Carolina where a variety of species, including hard clams, marine shrimp, crawfish, baitfish (minnows), catfish, and striped and hybrid bass, are currently being cultured or examined because of their desirability for aquaculture. The potential for future aquaculture development is greatly enhanced due to the suitability of the climate, physiography, and other features of the state and region.

The South Carolina Sea Grant Consortium has played a pivotal role in developing the State strategy for aquaculture development. Consortium staff coordinated a series of planning meetings and, with the endorsement of the Joint Legislative Subcommittee on Aquaculture, prepared and produced the "Strategic Plan for Aquaculture Development in South Carolina" in January 1989. The Subcommittee has asked the Consortium to oversee the implementation of the Plan's 40

recommendations; an effort that will continue for the next several years.

The South Carolina Sea Grant Consortium continues to aggressively support aquaculture research and extension activities. These efforts directly benefit from the James M. Waddell, Jr. Mariculture Research and Development Center at Victoria Bluff, South Carolina. The Center, which represents a significant commitment by the state to aquaculture, houses state-of-the-art facilities and equipment available to faculty and staff conducting aquaculture research and extension activities. The Consortium works closely with the Center to improve opportunities for the private sector in their aquaculture pursuits.

Hard Clam Genetics Subprogram. The hard clam fishery (Mercenaria spp.) has suffered significant declines in total landings over the last three decades despite high demand and correspondingly high value. Subsequently, the development of hard clam mariculture to supplement the over-exploited fishery has proceeded rapidly and today enjoys considerable commercial development and promise. To achieve economic feasibility, most commercial mariculture operations must rely on extensive field growout procedures for hatchery- and nursery-reared seed. These procedures, while cost effective for large scale operations, allow considerable loss of stock over the average three- to four-year growout cycle. Decreasing total field exposure time during growout would significantly increase economic returns. Growout data from South Carolina indicates that a 25 percent increase in growth rate could decrease field growout time by about eight months. This would make commercial hard clam mariculture much more attractive to investment because time to initial cash flow would be reduced and total return on investment would increase.

Genetic manipulation to produce faster growing cultivated stocks is a reasonable extension of aquaculture research with immediate application to commercial interests. Although some stock improvements in cultured clams have been derived through breeding programs at commercial facilities, no strict application of quantitative genetics to commercial-scale selected breeding has been performed. The potential for genetic improvements in hard clams is great considering their ease of breeding and genetic manipulation, the large variation existing in unselected wildstock, the availability of related species for hybridization, high individual fecundity, and the existence of selected stocks from commercial and research facilities. These attributes, coupled

with results of previous and ongoing studies, indicate that a large and rapid improvement in growth and survival of hard clam stocks through genetic manipulation is within the capabilities of present technology.

The main objective of the Hard Clam Genetics Subprogram has been the development of improved stocks of hard clams suitable for reliable and efficient culture. Secondary goals are the development of technology to improve breeding and culture methodologies, and the accumulation of information on molluscan physiology, genetics, and reproductive biology. This Subprogram proposes to accomplish these goals through an interdisciplinary, multi-institutional approach involving a cooperative research project on the applied breeding of the hard clam, Mercenaria mercenaria.

The final year of this eight-year project is focused on the completion of the following objectives:

(1) evaluate performance of lines produced in previous grant years,

(2) produce third generation of selected stocks (F_4) and compare with wild and parental (F_1) controls,

(3) determine gametogenic activity and spawning performance of polyploid clam stocks,

(4) develop optimal conditioning windows and gamete storage procedures,

(5) complete genetic survey of wild Mercenaria populations and examine the inheritance of shell morphology,

(6) investigate various archiving schemes and develop a system suitable to the stocks derived from this program,

(7) produce seed for testing in commercial shellfish operations, and

(8) produce technical and extension publications and participate in workshops and conferences to disseminate information derived from this study, in cooperation with the Marine Extension Program.

In addition, research examining the possibility that increases in growth rates in genetic stocks occur through partitioning of energy from reproduction to

growth is being completed. Currently, investigators are attempting to (1) determine gametogenesis and fecundity of cultured stocks, polyploids and hybrids and (2) determine the optimum conditioning window for cultured stocks used in the breeding program.

The program has received considerable direction from meetings of principal investigators with geneticists already working with bivalves (Gary Newkirk, Dalhousie University; Laura Adamkewicz, George Mason University; Richard Koehn, SUNY, Stonybrook; John Crenshaw, Georgia Tech). Principal investigators meet quarterly to evaluate status of the projects and suggest alterations in methodology or direction. A mid-program panel review of the entire program was held in December 1986 to provide outside evaluation of the subprogram. This panel of SCSGC reviewers included Don Squires (University of Connecticut), John Kraeuter (Baltimore Gas and Electric), Laura Adamkewicz (George Mason University) and Dennis Hedgecock (University of California). Program goals and progress in achieving these goals are thus reviewed regularly and revisions made when appropriate. Feedback from projects investigating allozyme variation, reproductive cycles and physiological performance guides the breeding phase of the program in choosing the most advantageous strategies to pursue and in discontinuing strategies which are not proving productive.

The Hard Clam Genetics Subprogram is highly interdependent. The associated projects on allozyme variation, reproductive analyses and physiological assessment could not exist without the breeding project, which produces the lines for analysis. The breeding program's success depends on feedback from those associated projects to evaluate the success of different breeding strategies. In addition to this necessary interdependence, the interdisciplinary approach of the hard clam genetics subprogram assures that considerable information on the physiology, genetics and reproduction of the hard clam will be derived even if none of the breeding schemes successfully produces improved strains. This large body of information will improve our understanding of the biology of bivalves in general and may lead to improved techniques for breeding and culture which will be of value to commercial mariculture and fishery management.

Hybrid Striped Bass Subprogram. The aquaculture of finfish has shown great promise in South Carolina, and has been the source of innovative cooperation between the public and private sectors. Indeed, techniques developed and information derived from South Carolina

Sea Grant support of hybrid striped bass research are now being used by culturists in Maryland, North Carolina, Georgia and other states where hybrid bass culture is permitted. Although these states have been involved with the growth of this industry for many years, it has only been since 1988 that it has been legal to commercially culture hybrids in South Carolina. However, in that short time, eight private growers have developed hybrid operations. This is due in large part to the information and techniques developed over the last six years through Sea Grant.

Considerable interest has been focused on the evidence that N-3 PUFA in marine lipids reduce the risks of cardiovascular disease and have an ameliorating action on other diseases. The fatty acid composition of animal fat can be altered by diet, including that of cultured fish, but to what extent and what effect it has on the health of the fish and its organoleptic quality is unknown.

For the second year of a two-year project initiated in FY90 by researchers at Clemson University and NMFS-Charleston, the influence of N-3 lipids and N-3:N-6 ratios on the health and post-harvest quality of hybrid striped bass is being examined. Specifically, the study is determining (1) the level of N-3 fatty acids that can be incorporated into hybrids, (2) the effects of N-3 fatty acids and ratios of N-3:N-6 lipids on the physiological well-being of hybrids, and (3) the effects of N-3 and ratios of N-3:N-6 fatty acids on the oxidation, functionality and sensory attributes of the muscle after the dietary treatments and during storage. Defining the nutritional concentration of N-3 PUFA required to produce a healthy, high quality, good-tasting fish would provide the necessary information and guidelines to extend the market potential for hybrids.

Marine Environmental Research

Continued interest in the marine and coastal environment is based primarily on its natural resource potential and economic value. Exploitation of the various resources available along the coast has led to increasing demand and competition for the right and access to those resources. Coupled with increased utilization -- e.g., industrial development, agriculture, shipping, fishing, and recreation -- impacts on the marine environment, in one form or another, are inevitable. Encouraging harmony among all users of the coast and the marine environment must be one of the overall goals of managers responsible for ensuring the wise use and controlled development of the state's natural resources.

The South Carolina Sea Grant Consortium is committed to providing information and data to natural resource agencies and users for use towards minimizing and mitigating environmental effects resulting from these increasing pressures. A major area of concern has been identified by the Consortium - the study of estuarine systems - and forms the basis for the research supported this year.

Estuarine Subprogram

Estuaries of the United States are considered one of the most productive ecosystems in the world: significant economic development depends on the maintenance of high quality estuarine systems. Many commercially- and recreationally-important fisheries species spend at least a portion of their life cycle in estuarine environments. Estuaries serve as buffer zones between freshwater riverine systems and the coastal ocean. They receive and process large inputs of freshwater, sediments, nutrients, and other materials that drain from terrestrial-based watersheds. However, the physical, chemical, and biological processes that control these functions are far from being adequately understood.

At recent symposia designed to develop research strategies and management options for U.S. estuaries, estuarine scientists and managers identified five basic categories of research: water inflows, sediment inflows, nutrients and other chemicals, the coupling of primary and secondary productivity, and fisheries habitat. These areas have been re-emphasized in NOAA's Estuarine and Coastal Ocean Science Framework. The S.C. Sea Grant Consortium has identified priority needs for its Estuarine Subprogram within the research framework established through these sessions.

The primary focus of the Consortium's Estuarine Subprogram has been on Charleston Harbor Estuary. Charleston Harbor, formed by the confluence of the Ashley and Cooper Rivers, is part of the second largest watershed on the East Coast (Santee-Cooper Watershed = 16,800 square miles). The Harbor is the site of major military, port, industrial, commercial, resort, and residential activities. It has also been influenced by two major engineering projects: diversion of 80 percent of the freshwater flow out of the system and into the Santee River in 1942; and rediversion of 80 percent of these waters back into the system in 1985. As a result, Charleston Harbor Estuary presents a unique opportunity for the examination of a highly dynamic and heavily impacted system.

The scope of the Estuarine Subprogram has focused on elucidating the physical and biological nature of estuaries. Consortium efforts have been strengthened through collaboration with the NOS Office of Oceanography and Marine Assessment, which has collected data on current and tide fluctuations through the deployment of RADS technology in the Harbor. Additionally, monies provided through the NOAA Office of Ocean and Coastal Resources Management have been supporting several efforts to characterize the biological, physical and chemical attributes of the estuary. Recent Sea Grant studies concentrated on the utilization and diet of estuarine habitat by penaeid shrimp, and the influences of physical processes, such as circulation and dispersion, on biological processes. The Consortium augmented its efforts in FY88-89 by adding two components to further characterize the Charleston Harbor estuarine system. These investigations focus on nutrient dynamics and the response of wetlands to changes in freshwater flow.

Estuarine scientists recognize that physical processes affect species recruitment and habitat utilization, species composition and productivity, nutrient dynamics, sediment transport, and pollutant transport and dispersion. It is therefore extremely important that these physical processes, including their variability, are understood. Last year, a continuing effort to characterize the physical oceanographic conditions in Charleston Harbor was completed. The work (1) simulated estuarine responses to changing freshwater flow, rising sea level, tides, and meteorological forcing; (2) measured, modeled and verified time and space variations in salinity; (3) identified and characterized dominant dispersion mechanisms; (4) calculated material fluxes along the river-estuary system and between the estuary and adjacent wetlands; and (5) estimated local material sources and sinks along the estuarine salinity gradient. The results of these oceanographic studies in Charleston Harbor Estuary have provided the basis for an improved understanding of the inherent biological and chemical variability in estuarine systems, critical for any attempts to manage the resource and man's impact upon it.

The rapid and continued commercial and residential development around the Charleston Harbor Estuary undoubtedly affects water quality. Human activities and natural processes influence the distribution and dispersion of nutrient elements. The rediversion of the Cooper River with its increased freshwater flow has also modified nutrient inputs. However, little basic information exists on the nutrient dynamics of the

estuary, making it difficult for managers to predict the potential water quality changes associated with increased anthropogenic inputs. A continuing project seeks to develop an ecological-water quality model for the Cooper River portion of the estuary, placing special emphasis on the relationships among river discharge, non-point source loading and river-wetland interactions. Objectives for the study are to (1) develop preliminary models of estuarine water quality dynamics by merging existing information on carbon and nutrient distributions with that on wetland distributions and estuarine hydrography and (2) quantify the functional role of selected watersheds and their dominant wetland habitats in modifying estuarine distributions of water quality parameters. These efforts will lead to the integration of resultant information with existing water quality and estuarine ecology models towards the development of a comprehensive management tool for the estuary.

The Cooper River rediversion has resulted in a reduction in freshwater discharge from 423 to 130 m/s. As a result of reduced freshwater runoff, the isohalines in the Cooper River portion of the estuary have significantly shifted upstream, resulting in a shift in the boundary between fresh and salt water intertidal wetlands. The remaining two years of a three-year study initiated in September 1989 will examine the effects of the changing salinity regime upon intertidal macrophyte wetland communities. The project will (1) develop and apply a salt balance model for intertidal sediments on the Cooper River, (2) determine species composition and biomass of intertidal wetland communities on the Cooper River in relation to the history of freshwater discharge, flood frequency and salt intrusion and (3) determine rates of methanogenesis from intertidal sediments in relation to salinity. The information gained in this project will offer a means of predicting how macrophyte communities will change in response to increased salt water intrusion, and how their productivity will be affected during the transition. It will also provide preliminary information necessary to predict the longer term effects of sea level rise.

Coastal Resources Development and Management

Coastal resource management issues in South Carolina are of the utmost importance to coastal zone planners, managers, developers, and those involved in commerce, industry, recreation, and tourism. The State has an approved Section 306 Coastal Zone Management Program administered by the South Carolina Coastal Council to encourage the preservation and wise development of

coastal and marine resources. The Program seeks to balance the needs of many diverse interests and thereby avoid use conflicts.

The South Carolina Sea Grant Consortium plans to continue examining coastal management issues in cooperation with the S.C. Coastal Council, other management agencies, and coastal user-groups. Research, education, and extension projects dealing with economics, policy, law, regulation, preservation and development of the coast will provide the basis for the development of future Consortium efforts. Needs of the state and region will thus be served simultaneously in terms of coastal decision-making, planning, and assessment.

Bioengineering and Marine Technology

In an increasingly competitive economy, industry spends billions of dollars each year on the research and development of new and better products. Recently, attention has been focused on the exploration of marine sources for these products. Such explorations have been enhanced by the creation of a field of scientific activity called biotechnology. Arising out of new developments in molecular biology and biochemical engineering, advances in biotechnology have allowed scientists and researchers to study biological phenomena as they apply to the manufacturing and service industries. Biotechnology research within the marine environment has focused on the effect of technological processes upon marine organisms and the effect of these organisms and their metabolites upon marine technologies. Already, marine biotechnology research has made significant contributions to the energy, food, pharmaceutical, biomaterial and pollution control industries.

The South Carolina Sea Grant Consortium continues to support research that seeks to advance polymer technologies used in industry that are based upon biodegradable polypeptides.

Coastal Processes

The coastal zone of South Carolina can be divided into three segments. The morphology of the coast is typically represented as a transition zone between the North Carolina and Georgia coastlines. From the North Carolina border to Winyah Bay, the Coast is an arcuate strand, with broad sandy beaches, few inlets, well-developed dunes and sparse salt marshes. It is an area which includes a significant tourism and recreation industry in Myrtle Beach, and an industrial base in

Georgetown. The southern section of the coast is dominated by a series of barrier islands, separated from the mainland by miles of tidal creeks and wide areas of salt marsh. There are few dune systems; rather, tidal inlets are prevalent. Population and industrial growth along this coastal region has remained slow due to these features. However, the numerous barrier and sea islands have attracted vacationers and tourists, and form the hub of the resort industry. The central portion of the coast retains characteristics of both the northern and southern sections; it is also the major permanent population center in the South Carolina coastal zone.

The South Carolina coast is fronted by 159 miles of beach (= 10,000 acres) and 40 barrier islands. As a result of storms, rising sea level, and high rainfall and other natural events, waterfront property is continually subjected to unpredictable erosion and accretion cycles, inlet migrations, and other physical changes. The coast of South Carolina represents an area of primary economic, social, and environmental importance. The South Carolina Sea Grant Consortium seeks, in examining coastal process questions, to address the needs of residents who live and work along the coast by providing information on the natural processes that affect their property and livelihood.

Marine Outreach Programs

Marine Outreach Programs represent the Consortium's overall commitment to provide information to public and private constituents concerning use and management of coastal resources. Projects in education and extension services were the focus of the Consortium's outreach program during FY1991-92.

Marine Extension Program

The South Carolina Marine Extension Program (MEP) was reorganized in 1987 to more effectively provide advisory services to the coastal community. In the restructured program, the South Carolina Sea Grant Consortium continues the cooperative arrangement with the Clemson University Cooperative Extension Service (CES). Program direction and oversight are maintained by the Consortium while CES provides the basic extension personnel and work plans to support general constituent needs. Other more specific needs are addressed through specialist projects within Consortium member institutions. This structure allows the MEP to maintain a core unit of permanent personnel under CES while also having the flexibility to contract experts for specific extension needs.

The Marine Extension Program has defined four primary program areas to respond to coastal user needs:

* economic development and resource management
* aquaculture
* coastal processes
* marine education and information services

Within these areas MEP activities are targeted toward alleviating problems posed by inadequate understanding of coastal resources and appropriate use technologies, as well as hazards inherent to various uses of the coastal environment. Information delivery is closely coordinated with the Consortium's Communications and Information Services program.

The South Carolina Marine Extension Program designs its activities to meet needs of various marine resource users and provides information necessary to ensure wise and effective use of South Carolina's marine resources. Through MEP's identification of needs, related research needs can be addressed in a responsive and efficient manner. MEP cooperative efforts in the development of new technology and provision of extension services to coastal and marine-related businesses will enhance the sound growth of the economy of South Carolina, as well as sustained management of the coastal resources essential to this growth.

Recent program accomplishments include: a project to demonstrate fuel savings potential of a new webbing material for commercial shrimp nets; development of a South Carolina Water Trails System in support of nature-based tourism; rapid growth (to almost $1 million annually) of the hybrid striped bass industry; workshops to promote xeriscaping in coastal development schemes; establishment of a volunteer water quality monitoring program in the Charleston Harbor estuary, involving 50 adults and 30 high school students; coordination of marine 4-H camps; development of a series of activity handbooks called "Sea Things...Objectively" for grades 1 through 5; and leadership in the S.C. Marine Educators Association. In addition, the MEP works closely with other Sea Grant programs, the SEMAS network, the National Marine Fisheries Service, other state and federal agencies, and others to provide timely delivery of practical information to various user groups and the general public.

Other Extension Projects

The South Carolina Sea Grant Program has committed significant resources to aquaculture research and

development and technology transfer over the last ten years.

For the last six years, the Consortium has supported the development of hybrid striped bass aquaculture. In 1988, under the MEP "Core" project, a four-year hybrid striped bass extension effort was initiated. The primary objective of the effort is the transfer of existing hybrid bass culture technology from the research community to the private sector. The hybrid bass extension project has developed cooperative programs with eight private farmers in South Carolina, using a combination of on-site training and special workshops. The project (1) provided management recommendations to the eight growers, (2) demonstrated hands-on hatchery procedures, (3) demonstrated pond stocking and harvesting techniques and (4) provided marketing assistance. The effort also involved (1) conducting hybrid bass culture workshops for farmers and extension personnel, (2) preparing extension fact sheets and training videos and (3) summarizing and publishing results of the program.

Communications and Information Services Program

The Communications and Information Services (CIS) program of the S.C. Sea Grant Consortium supports the agency's overall mission by developing and implementing communications programs that enhance sustained economic development and management of coastal and marine resources. CIS does this by identifying users and managers of coastal resources and providing them with information to address problems, enhance opportunities and increase awareness of the marine and coastal environment.

CIS complements and works closely with the S.C. Marine Extension Program by producing and distributing information products, maintaining contacts with the mass media in the state and region, and using a number of other outlets to transfer information and technology to the general public and specific user groups.

Specific goals of the CIS program are to:

* raise statewide awareness of the innerconnectedness of our state's waterways with the coast;
* raise public awareness about the value and dynamic nature of the coastal ocean, as well as our impact upon this resource;
* provide educational products and services to alert coastal constituents to changes in climate and hazards along the coast and how

they can appropriately prepare and respond to them;
* identify and promote innovative approaches to appropriate economic development (specifically in the areas of recreation, tourism, and alternative business enterprises) that also contribute tot he sustainable use of coastal resources);
* support through the production and distribution of publications, articles and products information about emerging technology that will have an impact on coastal users and managers;
* enhance the use of marine and coastal resource information in informal and formal educational settings; and
* raise public awareness of the mission, goals and benefits of the S.C. Sea Grant Consortium

Examples of CIS activities over the 1991-92 fiscal year include the following.

Program Awards

The Consortium's quarterly newsletter, Coastal Heritage, received national recognition as the second-place award recipient of the National Association of Governmental Communications (Fall 1991, Winter 1991-92, and Spring 1992 issues).

The 1991 Beach Sweep/River Sweep program set a new state record for the number of volunteers who turned out for the state's largest organized one-day cleanup. Some 7,176 volunteers collected more than 62.5 tons of debris, much of which was recycled. The program was recognized on the state level with a "Take Pride in America" award from Gov. Carroll Campbell and went on to be named a finalist on the national level.

Media Education

During 1991-92, CIS:

* distributed 20 news releases statewide, 4 radio public service announcements, and 4 television features;
* placed an estimated 147 newspaper articles;
* distributed a brochure detailing Sea Grant's mission and work to news media; and
* supplied hurricane preparedness and recovery information, as well as a brochure on the media's role in a disaster, to the New England states hit by Hurricane Bob in the fall of 1991.

Accomplishments in Agency Thematic Areas

During 1991-92, CIS supported the four thematic areas established by the S.C. Sea Grant as follows:

Aquaculture: The potential for growth of the aquaculture industry in South Carolina is great. Sea Grant has always provided substantial support of aquaculture research, extension and information products. Key projects conducted in support of this thematic area over 1991-92 include:

* provided publications and promotional support for the "Conference and Workshop on the Introduction and Transfer of Marine Species" in September 1991, including two brochures and conference proceedings.
* provided publications and promotional support for "Workshop for Hard Clam Watermen" in March 1992.
* reprinted the marine extension publication, Commercial Crawfish Production: A Guide for Prospective Culturists.
* marketed Frontiers of Shrimp Research.
* produced and informational and membership recruitment brochure for the S.C. Aquaculture Association.

Economic Development and Resource Management: A healthy state economy depends upon healthy coastal products. To raise awareness of the value of a healthy coastal environment, CIS undertakes a variety of outreach efforts concerning water quality, wetlands, marine debris, marine animal communities, oceanography, marine plant communities and waterbirds. CIS's goal is to increase public knowledge about the coastal environment and to promote sustained use and management of its resources. To this end, CIS undertook and successfully completed the following activities:

* The 1991 Beach Sweep/River Sweep program, organized by Sea Grant, S.C. Water Resources Commission and S.C. Clean & Beautiful, set new state records for South Carolina's largest organized one-day cleanup. 7,176 volunteers collected more than 62.5 tons of debris during the Sept. 21 event. Sea Grant earned recognition on the state and national level in the Take Pride in America awards for this program.
* 5,000 watershed posters, targeted toward 5th, 6th and 7th graders were printed and distributed to South Carolina teachers. These posters illustrated, through colorful

graphics and text, the innerconnectedness of South Carolina's rivers, lakes, estuaries and the coastal ocean. Half of the printing cost was underwritten as a Beach Sweep contribution by private industry.

* The four issues of the Consortium's quarterly newsletter, Coastal Heritage, published during this fiscal year were devoted to topics dealing with managing our resources for sustained economic growth.
    * The summer 1991 issue was devoted to the idea of conserving our coastal resources from the perspective of tourism, South Carolina's second largest industry. The issue was titled The New Tourism: Blending Development with Community.
    * The fall 1991 issue dealt with the sustainable use of one of our most valuable natural resources, clean drinking water. This topic, titled, Coastal Drinking Water: Good to the Last Drop?, was also the theme for the Consortium's annual mid-winter conference, which provided the general public, as well as water/utility managers with a forum to discuss the future availability and cost of this resource.
    * The winter 1992-92 issue emphasized the value of our coastal ocean and was titled South Carolina's Coastal Ocean: Sustaining our Riches Into the 1990's.
    * The spring 1992 issue, South Carolina's Rural Life: Preserving a Culture, highlighted the richness of our state's rural culture and traditional agricultural industries.

* CIS published three publications on water quality and coastal resources in cooperation with Clemson Extension Service.
* CIS played a significant role on the local arrangements and publicity committees of the 24th Annual International Community Development Conference held in July 1992.
* A CIS staff member participated on the site visit team to Atlantic Beach in October 1991 organized by the S.C. Downtown Development Association.
* CIS promoted two wetlands public forums along the coast.
* CIS reprinted 500 wetlands brochures for distribution to the public.

* CIS Distributed Xeriscape™ manuals to the public.
* In March, a directory of researchers involved with coastal ocean research (COBIA) was published and distributed.

Coastal Processes: Through various publications and promotional outlets, CIS supports research and technology transfer concerning storm, beach erosion, coastal construction, water safety, sediment transport, inlet formation, climate change and sea-level rise. CIS's goal is to increase public knowledge of how coastal processes are integral to life along the shore and should be factored into state, country and municipal planning. Activities include:

* Appropriate information about hurricane preparation and recovery was forwarded to the Northeastern states when Hurricane Bob came ashore in the fall.
* CIS produced Vol.II of the Characterization of Physical, Chemical and Biological Conditions and Trends in Three S.C. Estuaries: 1970-1985.
* The slide show, "How to Build A Dune," was shown in various locations around the coastal areas of the state.

Marine Education: S.C. Sea Grant's marine education agenda focuses on school curricula, informal educational opportunities, and volunteer monitoring programs. The two largest ongoing projects in this area, Beach Sweep/River Sweep and the annual mid-winter conference, have been discussed above. In addition to these programs and the accompanying watershed posted described above, CIS also played key roles in marine education by:

* Being represented at educational fairs and festivals around the state, including the Southeastern Wildlife Expo, the S.C. Aquaculture Festival, Earth Day, the S.C. Marine Fishing Fair, the S.C. Shrimp Festival, the LowCountry Fair, and others.
* Provided programs for a variety of school-aged children through library and scouting programs.
* Produced and distributed a consumers' guide to publications produced and distributed by the S.C. Sea Grant Consortium.

Service to Other Public Agencies

The South Carolina Sea Grant Consortium has assisted other public agencies with several tasks during FY91-92. The Executive Director continues to chair the Interagency Advisory Staff of the Joint Legislative Aquaculture Committee, which oversaw the development of the "Strategic Plan for Aquaculture Development in South Carolina," coordinated and published by the Consortium.

In early 1990, the Consortium was asked to participate in the development of a State Hazards Mitigation Plan under the auspices of the Governor's Office. The Consortium staff served on the Executive Committee and played a major role in the development of the plan.

In addition, the Consortium Executive Director was invited to contribute to the development of a South Carolina Energy Policy through participation on the Joint Legislative Energy Committee co-chaired by Rep. Harriet Keyserling and Rep. Robert Barber, and served as chair of a subcommittee. The resulting report provided the basis for the development of legislation that was enacted by the General Assembly in June 1992.

Other Grants and Activities

The Consortium supports a variety of programs and activities to meet its goal and objectives. Projects undertaken with Sea Grant support represent the core elements of the Consortium's programs. Pass-through grants and extramural projects are initiated to complement the Sea Grant effort at this time; the future of the Consortium lies in its ability to increase its non-Sea Grant program support.

For fiscal year 1991-1992, the S.C. Sea Grant Consortium obtained funding support from the following organizations for the following activities:

1. National Marine Fisheries Service - NOAA

* "Support for a Conference and Workshop on Introductions and Transfers of Marine Species" - M.R. DeVoe (SCSGC) - $5,000.

2. Coastal Ocean Program - NOAA

* "Feasibility Study to Determine Optimum Methods for Producing COASTWATCH Deliverables in Two South Carolina Environments" - D. Cowan and J. Jensen (University of South Carolina) - $74,729.

* "The Acute Toxicity and Bioaccumulation of Azinophosmethyl in Benthic Copepods and the Development of a Model for the Trophic Transfer of Non-Persistent Pesticides to Recreationally Important Finfish Species" - T. Chandler (University of South Carolina) - $42,872.

* "Support of COBIA Workshops" - M.A. Davidson (SCSGC) - $20,000.

3. NOAA Fleet

* "Continuation of Sediment - Water Interface Studies (November, 1991 - NOAA Ship FERREL)" - T. Tisue (Clemson) - Value = $56,000.

* "Continuation of Sediment - Water Interface Studies (March, 1992 - NOAA Ship FERREL)" - T. Tisue (Clemson) - Value = $77,000.

4. National Coastal Resources Research and Development Institute - NOAA

* "Nature-Based Tourism Enterprise: An Alternative for Rural Coastal Economic Enhancement" - R. Becker (Clemson) - $32,410 (Yr. 2).

* "Demonstration and Evaluation of the Performance of a Tidal-Powered Upwelling System in South Carolina" - R. Baldwin (Lowcountry Seafood) - $23,291.

5. U.S. Fish and Wildlife Service

* "Support for a Conference and Workshop on the Introductions and Transfers of Marine Species" - M.R. DeVoe (SCSGC) - $3,000.

6. U.S. Army Corps of Engineers

* "Description of Managed Coastal Wetland Impoundments at the Tom Yawkey Wildlife Center and Santee Coastal Reserve" - M.R. DeVoe (SCSGC) - $3,500.

* Annotated Summary of Existing Data and Information on Coastal Inlets in South Carolina" - E.J. Hayter (Clemson) - $2,450.

7. S.C. Department of Health and Environmental Control

* "Development of Public Education Materials on Non-Point Source Pollution" - M. Goodwin (SCSGC) - $17,000.

8. S.C. Water Resources Commission

* "Development and Delivery of an Integrated Resources Education Program" - M.A. Davidson (SCSGC) - $10,000.

9. S.C. Humanities Council

* "Five Hundred Years - S.C. Maritime History" - R. Raynor (MUSC) - $5,697.

10. College of Charleston

* "Partial Support of the COBIA Project Manager Position" - M.A. Davidson (SCSGC) - $10,674.

11. City of Charleston - Commissioners of Public Works

* "A Study of Impacts Resulting from Pipeline Installation and Mitigation Efforts on Selected Saltmarsh Ecosystem Components in the Ashley River and Wappoo Creek" - M. Goodwin (SCSGC) - FY91 - $41,291 + $50,000.

12. Washington Light Infantry

* "Characterization of the Physical, Chemical and Biological Properties of Charleston Harbor and its Near Coastal Waters" - M.A. Davidson (SCSGC) - $5,400.

13. SCANA Corporation

* "Head Start for Science: Expansion of Minority Student Access to Science" - M.A. Davidson (SCSGC) - $3,000.

14. Private Funds (misc.)

* "Determination of the Distribution, Abundance, and Status of Colonial Nesting Waterbirds in South Carolina" - T.M. Murray and P.M. Wilkinson (SCWMRD) - FY91 - $17,827.

* "Support for the Harborwatch Volunteer Monitoring Program" - M. Goodwin (SCSGC) - $1,500.

EFFICIENCY AND EFFECTIVENESS MEASURES

The South Carolina Sea Grant Consortium, in accordance with the requirements of Act 189, Section 129.50, have developed the following efficiency and effectiveness measures. These requirements were established in Proviso 129.50 of the FY89-90 Appropriations Act and their development was requested in December 1989.

Overall Mission Statement

To develop, support, improve and coordinate research, education, training and extension efforts that enhance the economic development, proper management and conservation of coastal and marine resources in the State and region, through administration of the Sea Grant Program and in cooperation with appropriate institutions, programs and persons in the region.

Program Title:

Administration

Program Performance Measures:

Effectiveness:

1. Contacts made through mass media efforts in FY91-92 over previous years.

Performance:

Number of Media Placements (FY91-92)	=	173
Number of Media Placements (FY90-91)	=	172
Number of Media Placements (FY89-90)	=	219
Number of Media Placements (FY88-89)	=	152

2. Public school science teachers and students exposed to and/or using marine education materials in FY91-92 over previous years.

Performance:

Number of Teachers/Students (FY91-92)	=	3,432
Number of Teachers/Students (FY90-91)	=	3,312
Number of Teachers/Students (FY89-90)	=	1,726
Number of Teachers/Students (FY88-89)	=	1,108

3. Requests for information received by Consortium during FY91-92.

Performance:

Requests for information (FY91-92)	=	4,818
Requests for information (FY90-91)	=	7,205

4. Number of and enrollment at MEP workshops and demonstrations during FY91-92 compared to previous years.

Performance:

Number of Workshops (FY91-92)	=	109
Attendees (FY91-92)	=	8,636
Number of Workshops (FY90-91)	=	257
Attendees (FY90-91)	=	14,660
Number of Workshops (FY89-90)	=	85
Attendees (FY89-90)	=	7,500

5. Sea Grant project proposals reviewed by the National Sea Grant College Program Office that are deemed technically and conceptually sound in FY90-92 compared to previous biennial cycles.

Performance:

Percent of Proposals (FY90-92)	=	88.9%
Percent of Proposals (FY88-90)	=	81.3%

6. Investigators, professionals and students supported through Sea Grant research, extension and education projects in FY90-91 compared to previous years.

Performance:

Number of Investigators (FY91-92)	=	46
Professionals (FY91-92)	=	9
Students (FY91-92)	=	21
Number of Investigators (FY90-91)	=	32
Professionals (FY90-91)	=	5
Students (FY90-91)	=	19
Number of Investigators (FY89-90)	=	22
Professionals (FY89-90)	=	14
Students (FY89-90)	=	24
Number of Investigators (FY88-89)	=	24
Professionals (FY88-89)	=	18
Students (FY88-89)	=	20

7. Percentage change in non-state program budget (research, extension and education activities) in FY 90-91 over previous year.

Performance:

Non-State Funds (FY91-92)		= $1,257,957.
% Change	= +21.9%	
Non-State Funds (FY90-91)		= $1,031,220.
% Change	= +10.3%	
Non-State Funds (FY89-90)		= $ 935,305.
% Change	= + 5.8%	
Non-State Funds (FY88-89)		= $ 883,700.

Efficiency:

1. Ratio of state financial support to total financial support.

Performance:

Ratio (FY91-92)	= 28.1%
Ratio (FY90-91)	= 33.4%
Ratio (FY89-90)	= 35.0%
Ratio (FY88-89)	= 34.9%

2. Average cost per constituent contact (based on the ratio of costs and distribution of publications to the cost of the Communications program).

Performance:

Cost per Constituent (FY91-92)	= $0.49
Cost per Constituent (FY90-91)	= $0.93
Cost per Constituent (FY89-90)	= $0.90

FISCAL REPORTS

Contents

Exhibit A

S.C. Sea Grant Consortium
Balance Sheet
June 30, 1992

Assets			Liability and Fund Balance		
Current Funds:			Current Funds:		
Cash on hand	$ 200		Unrestricted	$	
Prior year refund	172		Prior year refund	172	
State Treasurer	38		Due to State General Fund	238	
		$ 410			$ 410
Restricted Funds:			Restricted Funds:		
Due from Grantors	80,706		Revenue	135,680	
State Treasurer	135,680		Deferred Revenue	80,706	
		216,386			216,386
Total Funds		$216,796	Total Funds		$216,796
Fixed Assets			Fixed Assets Funds		
Equipment Inventory	157,359		Funds Balance	157,359	
Total Fixed Assets Funds		$157,359			$157,359

Exhibit B

S.C. Sea Grant Consortium
Statement of Changes in Current Operating Funds
Year Ended June 30, 1992

	Administration	
Balance July 1, 1991	$	$ 200
Additions:		
Preliminary Appropriation	529,956	
Appropriation Increases	203	
Total Additions		530,159
Deductions:		
Expenditures	492,033	
3.3% Appropriation Act Reduction	17,489	
1% Permanent Reduction	5,125	
2% Sequestered then Permanent Reduction	10,249	
1% Sequestered then Permanent Reduction	4,970	
Mandated B&C Bd. Reduction	255	
Total Deductions		530,121
Balance Due to the General Fund		$ 238

Exhibit C

S.C. Sea Grant Consortium
Statement of Changes in Restricted Funds
Year Ended June 30, 1992

	Balance 7/1/91	Total Additions	Total Deductions	Balance 6/30/92
Sea Grant Contracts	$	$	$	$
1987-88	<2,518>	2,518		-0-
1988-89	<201>	131		<70>
1990-91	<28,547>	426,297	396,319	1,431
1991-92		338,358	420,425	<82,067>
Other Federal Funds	<1,469>	131,032	125,564	3,999
Other Restricted Funds	113,128	156,313	137,760	131,681
Totals	$ 80,393	$1,054,649	$1,080,068	$ 54,974

Exhibit D

S.C. Sea Grant Consortium
Statement of Changes in Fixed Assets
Year Ended June 30, 1992

	Balance 7/1/91	Total Additions	Total Deductions	Balance 6/30/92
Capital Equipment	$140,462	$10,600	$ 7,207	$143,855
Motor Vehicle Equipment	13,504			13,504
Totals	$153,966	$10,600	$ 7,207	$157,359

Exhibit E

S.C. Sea Grant Consortium
Notes to Financial Statements
June 30, 1992

Note 1 - Summary of Significant Accounting Policies

Basis of Accounting:

The financial statements have been prepared on an accrual basis.

Funding Accounting:

To ensure observance of limitations and restrictions placed on the use of resources available to the Consortium, the accounts are maintained in accordance with the principles of fund accounting. This is the procedure by which resources for various purposes are classified for accounting and reporting purposes into funds that are in accordance with specified activities or objectives. Separate accounts are maintained for each fund.

General Fixed Assets:

Fixed assets are recorded as expenditures of the general operating fund upon acquisition and subsequently capitalized at actual cost in the general fixed asset account group. In accordance with generally accepted accounting principles prescribed for governmental funds, a provision for depreciation of general fixed assets is not recorded.

Grant Accounting:

The Consortium is a State agency involved in ocean and coastal research, education, and advisory extension work. It serves to encourage, coordinate and facilitate projects pertaining to coastal and ocean areas of South Carolina and to utilize the talents of its members to address marine issues and opportunities.

The Consortium identifies these projects through planning and priority setting exercises. The Consortium arranges for the design and implementation of the projects, usually through its member institutions. On a biennial basis, core projects are submitted to the National Sea Grant Program for funding. Additionally, the Consortium submits project proposals to federal, state and private funding agencies for consideration and support. A majority of the projects funded are then subcontracted to various member institutions.

Expenditures paid by the Consortium at June 30 and not yet reimbursed by the primary grantor are recorded as accounts receivable. Revenues received on specific grants which are in excess of expenditures are recorded as deferred revenues.

Note 2 - Retirement Plan

Substantially all employees of the Consortium are covered by a retirement plan through the South Carolina Retirement System. It was not feasible to separately identify current year retirement plan cost included as a portion of employer contributions in the accompanying financial statements.

Information regarding the excess, if any, applicable to the Consortium of the actuarially computed value of vested benefits over the total of the pension fund and any balance sheet accruals, less any pension prepayments of deferred charges is not available. By State Law, the Consortium's liability under the retirement plan is limited to the amounts appropriated therefore in the South Carolina Appropriation Act, plus the amount paid from other revenue sources for the current year. Accordingly the Consortium recognizes no contingent liability for unfunded costs associated with participation in the plan.

Note 3 - Contingent Liabilities

The Consortium has numerous contracts with the Federal Government, other State agencies and other funding sources for the reimbursement of specific costs related to the various programs described in each contract. Reimbursement costs subsequently deemed to be unallowable by the grantor, if any, would have to be repaid. A majority amount of the contracts are in turn subcontracted by the Consortium and reimbursed costs deemed to be unallowable would result in a claim by the Consortium against the subcontractor.

Note 4 - Changes in General Fixed Assets

Changes in general fixed assets for the year ended June 30, 1992 are as follows:

	Balance 7/1/91	Additions	Deletions	Balance 6/30/92
Equipment	$153,966	$10,600	$ 7,207	$157,359

Schedule I

S.C. Sea Grant Consortium
Schedule of Current Unrestricted Expenditures
Year Ended June 30, 1992

Title	Original Appropriations	Revised Appropriations	Expenditures	Balance
Personal Services	$ 272,511	$ 256,869	$ 256,868	$ 1
Contractual Services	53,784	39,402	39,401	1
State Development	45,028	39,094	39,094	-0-
Supplies	14,631	13,771	13,770	1
Fixed Charges	49,257	60,101	60,101	-0-
Travel	11,265	16,441	16,440	1
Equipment	807	441	441	-0-
Light, Power, Heat	4,351	4,413	4,412	1
Transportation	1,934	626	625	1
Employer Contributions	58,899	60,913	60,881	32
Total General Fund	$ 512,467	$ 492,071	$ 492,033	$ 38

Schedule I-A

S.C. Sea Grant Consortium
State Development Grants
Year Ended June 30, 1992

Title	Grantee	Expenditures
Travel Support	SCWMRD	$ 2,000
Chlorinated Phenolic Compounds	USC	2,270
Plant Fragment Analysis	USC	7,648
Genetics of the Hard Clam	USC	4,200
Protein from Oyster Shells	Clemson	19,911
McClellanville Resource Team Visit	SCDDA	1,750
Meeting Support	SC Amer Plan. Assoc	300
Sweetgrass Outreach Project	USC	1,315
Meeting Support	SCFWA	300
Totals		$ 39,694

Schedule II

S.C. Sea Grant Consortium
Schedule of Restricted Expenditures
Sea Grant 1990-91
Year Ended June 30, 1992

	Salaries	Fringe Benefits	Contract. Services	Sub Grants	Supplies	Fixed Charges	Travel	Equip	Total
Administration	$ 17,640	$ 4,667	$ 8,758	$ 1,560	$ 2,562	$	$ 5,741	$	$ 40,928
Sea Grant Abstracts				17,000					17,000
Development				68,496					68,496
Communications			4,902		5,383	354	786		11,425
Marine Ext Program	13,015	3,536	3,798	61,301	5	2,000	561	3,136	87,352
Sub Grants				143,577					143,577
Intern	12,000	918			5,506				18,424
NOS Workshop	2,455	504	2,956		565		272		6,752
Long Term Trends				1,472					1,472
NMPPO Printing			893						893
Totals	$ 45,110	$ 9,625	$ 21,307	$293,406	$14,021	$2,354	$7,360	$3,136	$396,319

Schedule II-A

S.C. Sea Grant Consortium
Sub-Grants
Sea Grant 1990-91
Year Ended June 30, 1991

	Grantee	Expenditures
Administration		
Travel Support	C of C	$ 353
Travel Support	SCWMRD	1,207
Sea Grant Abstracts		
Woods Hole Data Base Inc.	WHDBI	17,000
Development		
Genetics of the Hard Clam	USC	8,310
Protein from Oyster Shell	CU	24,259
Numerical Modeling	CU	2,520
Biopolymers Symposium	Univ of Alabama	1,000
Blue Crab Recruitment & Settlement	SCWMRD	6,947
Assess & Model Tidal Flow	USC	2,000
Mechanisms of Transport	Skidaway Inst.	8,000
Data Analysis in Chas Estuary	USC	15,000
NOAA Ship FERREL	USC	460
Sub-Grants		
Applied Breeding of the Hard Clam	SCWMRD	17,740
Applied Breeding of the Hard Clam	C of C	4,524
Applied Breeding of the Hard Clam	CU	13,709
Dietary Fatty Acids in Hybrid Striped Bass	CU	6,065
Estuarine Flow Transport	USC	17,656
Estuarine Nutrient Dynamics	USC	32,148
Intertidal Wetland Responses	USC	27,814
Hybrid Bass Tech to the Priv Sector	SCWMRD	23,922
Marine Extension Program		
Education	SCWMRD	11,842
Design of Roofs to Resist Wind Uplift	CU	21,092
Clemson Extension Service	CU	28,366
Long Term Trends		
Trends in Water Quality & Living Resources	USC	1,472
Total Sea Grant 1990-91 Sub-Grants		$293,406

Schedule III

S.C. Sea Grant Consortium
Schedule of Restricted Expenditures
Sea Grant 1991-92
Year Ended June 30, 1992

	Personal Services	Fringe Benefits	Contractual Services	Sub-Grants	Supplies	Fixed Charges	Travel	Equip.	Totals
Administration	$ 16,766	$ 2,541	$12,779	$ 1,651	$ 4,602	$ 633	$ 6,104	$	$ 45,076
Sea Grant Abstracts				62,067					62,067
Development				28,859					28,859
Communications	9,170	1,513	30,174		6,749	690	1,230	601	50,127
Sub-Grants				131,517					131,517
Marine Extension Prog.	30,726	4,799	8,734	55,591	1,004	30	473	1,422	102,779
Totals	$ 56,662	$ 8,853	$51,687	$279,685	$12,355	$1,353	$ 7,807	$2,023	$420,425

Schedule III-A

S.C. Sea Grant Consortium
Sub-Grants
Sea Grant 1991-92
Year Ended June 30, 1992

	Grantee	Expenditures
Administration		
Travel Support	CU	$ 1,569
Travel Support	USC	82
Sea Grant Abstracts		
Woods Hole Data Base, Inc.	WHDBI	62,067
Development		
Protein from Oysters	CU	3,615
Marine Species Conference	In-House	1,992
Climatic & Sea Level Changes	USC	2,118
Transport of Larval Fishes	SCWMRD	1,795
NOAA Ship FERREL Time	CU	5,000
Development of Techniques for Hybrid Bass	SCWMRD	5,610
Techniques for Modeling Flow	USC	3,000
Listeria Workshop Support	Univ of VA	500
Science Fair	C of C	1,500
Mapping Dispersal of Estuarine Plume	CU	2,200
Meiofauna Conference Support	Univ of MD	500
Study of the Daily Ingress of Larval Invertebrates	C of C	1,029
Sub-Grants		
Applied Breeding of the Hard Clam	SCWMRD	26,288
Applied Breeding of the Hard Clam	C of C	4,582
Genetics of the Hard Clam	USC	18,398
Dietary Fatty Acids in Hybrid Bass	CU	4,005
Estuarine Nutrient Dynamics	USC	17,229
Intertidal Wetland Responses	USC	40,502
Hybrid Bass Tech to the Private Sector	SCWMRD	20,513
Marine Extension Program		
Clemson Extension Service	CU	18,777
Design of Roofs to Resist Wind Uplift	CU	17,582
Education	SCWMRD	19,232
Total Sea Grant 1991-92 Sub-Grants		$279,685

Schedule IV

S.C. Sea Grant Consortium
Schedule of Restricted Expenditures
Other Federal Funds
Year Ended June 30, 1992

	Grantee	Contractual	Sub Grants	Supplies	Fixed Charges	Travel	Total
NCRI	Clemson	$	$ 26,179	$	$	$	$26,179
ACOE Impoundments	In-House	637					637
ACOE	In-House						-0-
Headstart for Sci	In-House						-0-
NEA-Sweetgrass Bask.	Mt.P.Sweetgrass		<895>				<895>
COBIA Feasibility	SCWMRD		60,684				60,684
COBIA Workshop	In-House	4,289		751	57	2,595	7,692
Benthic Copepods	USC		30,318				30,318
Nat'l Coastal Res.In	Clemson						-0-
Environmental Pro Ag	In-House						-0-
ACOE-Coastal Impacts	In-House	949					949
Totals		$ 5,875	$116,286	$ 751	$ 57	$ 2,595	$125,564

Schedule V

S.C. Sea Grant Consortium
Schedule of Other Restricted Expenditures
Year Ended June 30, 1992

	Personal Services	Fringe Benefits	Contrac. Services	Sub Grants	Supplies	Fixed Charges	Travel	Equip.	Total
Sale of Assets	$	$	$	$	$	$	$4,541	$	$ 4,541
Bird Guide				9,139	114				9,253
Beach/River Sweep	3,550	272	4,755		4,387		6		12,970
Communications Reprints									-0-
PICMD Caribbean									-0-
Recycling Guide									-0-
CPW Pipeline				73,288				4,247	77,535
Hybrid Bass Workshop									-0-
Donations Misc.			853		1,261				2,114
Harborwatch									1,160
SAMP					548				548
Marine Exo. Spe Conf.			4,163		100	554			4,817
Miscellaneous Research									-0-
NPS Information					455				455
WR4 Integrated Ed	6,219	1,528	200		136	110			8,193
C of C Sautter	7,045	1,490							8,535
Headstart for Science									-0-
SC Humanities-500 yrs.			260						260
Wetlands Ed Materials									-0-
PICMD-Donation								279	279
Hybrid Bass Donation				4,946			647		5,593
GCFI			33		1,000			474	1,507
PRT Folly Beach									-0-
Totals	$16,814	$3,290	$10,264	$87,373	$8,001	$664	$5,194	$5,000	$137,760

Schedule V-A

S.C. Sea Grant Consortium
Statement of Changes in Other Restricted Funds
Year Ended June 30, 1992

	Balance 7/1/91	Total Additions	Total Deductions	Balance 6/30/92
Sale of Assets	$ 5,020	$ 35	$ 4,541	$ 514
Bird Guide	14,782	12,761	9,253	18,290
Beach Sweep/River Sweep	8,302	9,230	12,970	4,562
Communications Reprints	3,318	1,215		4,533
PICMD - Caribbean	9			9
Recycling Guide	173			173
CPW Pipeline	1,331	91,291	77,535	15,087
Hybrid Bass Workshop	232			232
Donations-Miscellaneous	4,572	75	2,114	2,533
Harborwatch	160	1,000	1,160	-0-
SAMP	<214>	762	548	-0-
Marine Exotics Spec. Conf		7,450	4,817	2,633
Miscellaneous Research		5,400	-0-	5,400
NPS Information			455	<455>
WR4 Integrated Ed.	5,678	10,017	8,193	7,502
C of C Sautter		10,674	8,535	2,139
Headstart for Science		3,000		3,000
SC Humanities-500 yrs.		3,420	260	3,160
Wetlands Ed Material	17	<17>		-0-
PICMD Donation	279		279	-0-
Hybrid Bass Donation	67,954		5,593	62,361
GCFI	1,507		1,507	-0-
PRT - Folly Beach	8			8
Totals	$113,128	$156,313	$137,760	$131,681

Total Number of Documents Printed	100
Cost Per Unit	$ 4.43
Printing Cost - S.C. State Budget & Control Board (up to 255 copies)	$ 442.76
Printing Cost - Individual Agency (requesting over 255 copies and/or halftones)	$
Total Printing Cost	$ 442.76